Clinical Update

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# Digital photography

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## Introduction

Digital cameras are the biggest innovation in photography in over 100 years. Images recorded digitally have brilliance that nearly rivals 35mm film quality (1). They provide a myriad of advantages that simply cannot be achieved in a 35mm film system. The purpose of this clinical update is to inform the clinician about the basics of digital photography and to compare the advantages and disadvantages of digital photography to traditional 35mm film photography in the clinical setting.

## How digital cameras work

At the heart of every digital camera is the electronic sensor, usually a Charge Coupled Device (CCD), which records the image (2). When the shutter button is depressed, light enters the camera and strikes the CCD. The CCD is composed of thousands of microscopic dots called picture elements or "pixels." The information on the CCD is read one line at a time and sent to the internal memory of the camera, called the buffer. The internal memory stitches together all pixels into an image, and then compresses it (if selected) into Joint Photographic Expert Group (JPEG) format. A common 3 million-pixel JPEG image roughly converts into a 1MB file (2).

The first measure of digital quality is resolution, or the ability of the camera to resolve detail (3). Increasing the number of pixels increases the resolution. The number of pixels is commonly given as either the number of rows and columns of pixels on the CCD (1000 x 1200) or the product of multiplying the rows and columns (1.2 million pixels or 1.2 megapixel resolution) (3). A 6.1 megapixel image has approximately 75% of the image data found in a 35mm slide (2). To print a sharp 8” x 10” image, a camera capable of at least a 3-megapixel image is required. If the image to be printed is 5” x 7”, a 2 megapixel capable camera will suffice (4).

Sensors record the amount of light that hits them but not the color of that light. For the digital camera to detect color, a color filter is put over the individual sensors. Each sensor represents 1 pixel, and the actual 24-bit color is determined by the average of the pixel and its neighbors (2).

Images that are in the buffer are then saved to the storage media of the camera. This can be a floppy disk, CD, or memory card. Some cameras will need this process to finish before taking another image. Other cameras have an internal buffer that is large enough to hold several images and can therefore take multiple pictures in a rapid sequence, called burst shooting.

Cameras that store images on a floppy disk are limited to a maximum 1.44-MB. Some cameras can burn images directly to a CD. IBM's 1-gigabyte Microdrive can hold over 1000 high-resolution images (1). The two main types of memory cards are Compact Flash (CF) and Smart Media. Compact Flash II is a new standard with increased capacity. It is recommended that cards should hold a minimum of 4MB (4). Unlike CDs, memory cards are reusable. The sliver thin Smart Media cards are less durable with exposed contact edges that if deeply scratched make the card useless. CF cards are virtually indestructible. Additionally the images can be sent directly from the camera to the hard drive using a Firewire or USB port.

## Digital vs. 35mm Camera

Images produced by 35mm cameras have greater resolution when compared to digital images. F-stop and exposure time can be adjusted on most 35mm cameras thus allowing the photographer to produce special effects. They have both point and ring flash, while most digital cameras do not have a ring flash. The ring flash results in much better illumination throughout the oral cavity when compared to a point flash. Colors produced on film are more accurate. 35mm photography requires less of the clinician’s time to process the images, as once photography is complete the processing is out-sourced to a commercial lab. Digital photography requires far more of the clinician’s time. The images have to be downloaded to a computer, edited, and then archived, all of which takes time. Additionally, photographic images can be scanned on a high quality scanner to produce digital images that are of much greater quality than those achieved directly from a digital camera. A 24x36mm full frame 35mm image (negative or slide) scanned with a 2700 dpi (dots per

inch) scanner (under $500) results in a 9.4 megapixel (2496 x 3776) scan (2).

Digital cameras offer the advantage of viewing the images instantaneously. They can be deleted or accepted, and then catalogued and archived for instant retrieval. The need for retakes can be determined before the patient is dismissed. This virtually eliminates the possibility of poorly exposed, unfocused, or missed images. With 35mm photography, this cannot be determined until the film is returned from the photo lab. The biggest advantage of digital over traditional film is that the image can be edited easily on a computer. Thus less photographic skill is required because brightness, contrast and color can be adjusted and the image can be cropped. Furthermore, notations can be placed directly on the image. The images can then be printed, e-mailed for immediate consultation, or incorporated directly into a PowerPoint presentation. Copies are instant and virtually free. Digital cameras can hold far more images than the traditional 36-exposure roll of film. A digital camera set to take quality 5" x 7" photos can store about 180 photos with a 132MB memory card (2).

Currently the cost is nearly the same between 35mm and digital cameras. However, as technology advances, digital camera prices are decreasing and quality is increasing. While digital images can be produced from conventional film, it requires a scanner, which can add $500 to $1500 to the cost of the system and it requires more of the clinician's time.

**Choosing a digital camera**

So, what do you need to go digital? Look for a camera designed for intraoral photography with Through The Lens (TTL) light metering coordinated with a macro flash and macro lens. This will produce consistently higher quality images than "point and shoot" consumer level digital cameras. A simple system would require only a digital camera with a CD as its storage medium, and a computer system with a CD reader. A camera with at least 2 megapixel resolution will provide good quality images. The storage system should be able to store at least 20 photos at that resolution. This will eliminate cameras that use floppy disks.

For some additional cost, there are several "upgrades" that can both improve the quality of the image and simplify the process with which images are loaded from the camera to the computer. Cameras with higher resolution (currently up to 6.1 megapixel) will produce sharper images. Some have a large internal buffer capacity, which will allow burst shooting. Systems that utilize either the Compact Flash, Compact Flash II, or Smart Media memory cards greatly improve the storage capacity of the camera itself. Additionally some Compact Flash cards are forward and backward capable, meaning images can be loaded either direction between the computer and the camera. Systems using Firewire or USB port allow images to be transferred directly to the computer without the need to remove the storage system.

You may have already invested over a thousand dollars in a high quality 35mm system. The Nikon D1X, Fugifilm S1, and Canon EOS D30 are all recently introduced professional digital cameras based upon those familiar 35mm camera bodies and flash and lens systems. As a result, dental photographers may need to only purchase the camera body to go directly to digital (1).

Like the computer industry, digital imaging technology is rapidly improving and cost continues to decrease. Digital camera systems range in their sophistication from point and shoot to high-end professional systems. A wealth of information is available on the Internet, from the manufacturers, and in the literature. It would be prudent to take the time to do the research and make an informed choice before making the switch to digital.

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